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(19) (CA) **CANADIAN PATENT** (12)

(54) METHOD OF RELINING SEWERS AND WATER LINES WITHOUT  
EXCAVATION

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ABSTRACT OF THE DISCLOSURE

A method is disclosed for relining buried pipeline with interconnectable plastic type pipe sections. The method comprises gaining access to an open end of the buried pipeline, such as through a manhole, passing pipe sections down the manhole and inserting individually each pipe section into the buried pipeline open end. Each pipe section is of a length to permit, within the confines of the manhole, insertion of each pipe section into the pipeline open end. Each pipe is of a diameter to fit within the pipeline. The pipe section to be inserted is interconnected to the pipe section already inserted within the buried pipeline. Such interconnected sections are sequentially moved into the buried pipeline to permit insertion of the next pipe section into buried pipeline until the entire length of the pipeline to the next access area has been relined.

1     FIELD OF THE INVENTION

      This invention relates to a method for relining buried pipelines and product used in relining such pipelines.

BACKGROUND OF THE INVENTION

      There are many situations where there is a requirement to replace or repair pipelines in densely populated areas or inaccessible areas. The normal procedure for many years, which is particularly troublesome in congested cities, is to close off a street, dig up a buried damaged pipeline, install  
10    the new pipeline and repair the street. This is commonly done with city sewer and storm drain lines. However, there are many other areas where inaccessible faulty pipelines need to be relined.

      To reduce the need to dig a trench along the entire length of the pipeline to be replaced, this has been overcome by a process of inserting within a pipeline requiring replacement a plastic pipe liner. Such a method of relining sewer pipe is disclosed in Bremner, United States patent  
20    3,602,263. In his method as particularly directed to the relining of sewer mains, a reaming device is first passed through the old sewer line to remove tree roots, calcium deposit caked on the pipewalls and the like. A plastic pipe is passed through the reamed sewer line, the plastic pipe being of a lesser diameter than the reamed sewer line to form the new interior for the sewer line. The plastic piping, as fed into the sewer line, is commonly of polyethylene pipe where lengths of pipe are interconnected by the process of butt fusion welding, where the ends of pipe lengths to be  
30    joined are melted and in their softened state, connected to one another. Depending upon the length of the sewer line to



1 be relined, this determines the number of pipe sections which are joined together. Commonly the pipe sections are of fifty foot lengths and are interconnected by using expensive, difficult to operate butt fusion welding equipment. Such equipment requires skilled personnel on the job site.

Another approach in relining sewer lines and other buried service pipelines is disclosed in Levens, United States patent 3,950,461 and St. Onge, Canadian patent 1,033,197. In these patents, improved techniques are  
10 disclosed for connecting lateral sewer lines to a relined main sewer line. Such interconnection is made from a remote location within the house or building via the lateral sewer line.

The drawback of the above processes for relining buried pipelines is that, aside from the requirement of butt fusion welding to interconnect lengths of pipe to be drawn into the pipeline to be relined, it still requires excavation and interruption to the flow of vehicle traffic.

As to the aspect of interconnecting pipe sections,  
20 mechanical interconnection of pipe sections have been used, such as in the oil drilling field. Drill strings are mechanically interconnected as shown in Knox et al, United States patent 3,359,013, Duret, United States patent 3,508,771 and Hokanson et al, United States patent 3,667,784. However, in these arrangements the drill strings or casing joints are formed of steel and would be totally unacceptable for use in relining buried pipeline, because of their rigidity. Insofar as mechanical interconnection of larger diameter plastic pipe is concerned, clamps have been  
30 used, for example, as supplied by DuPont Canada and sold

1 under the trademark Sclairloc. Such couplings add large projections to pipe exterior making it unacceptable for relining pipelines by insertion renewal.

The method, according to this invention, provides for the relining of buried pipeline, where access thereto is difficult or impossible by excavation. The method provides for relining the pipeline without disturbing the surrounding street vehicle traffic by taking advantage of already provided accesses to the buried pipelines such as by manholes.

10 SUMMARY OF THE INVENTION

The method, according to this invention, for relining a buried pipeline with interconnectable plastic pipe sections comprises gaining access to an open end of the buried pipeline and passing pipe sections through the access area for assembly adjacent the open end of the buried pipeline. Each pipe section is individually inserted into the buried pipeline open end, where each pipe section is of a length to permit within the confines of the access area insertion of each pipe section into the pipeline open end and is of a diameter to fit within the pipeline. The pipe section to be inserted into the pipeline is mechanically interconnected with a pipe section already inserted in the pipeline. The interconnected pipe sections are sequentially moved after each interconnection into the buried pipeline to permit insertion and interconnection of the next pipe section into the buried pipeline. The pipe sections are made of polyvinylchloride polypropylene or polyethylene.

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The pipe, for use in relining buried pipelines, is substantially straight and has its ends adapted for interconnection of its ends to other \_\_\_\_\_

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1 like pipe lengths. The mating interconnection of pipe ends retains its integrity as interconnected lengths of pipe are moved within the buried pipeline to reline same. According to an aspect of the invention, male and female end portions are provided on each length of pipe which form a mating interconnectable interfit. Such male and female end portions may be buttress type threads, whereby relative rotation of each pipe section provides for a secure interconnection of the sections.

#### 10 BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings wherein:

Figure 1 is an elevation of a job site showing the relining of a buried pipeline according to the invention;

Figure 2 is a sectional elevation demonstrating a technique for moving connected sections of pipe lengths into the buried pipeline;

Figure 3 shows a plurality of pipe lengths interconnected by cooperation of male and female threads, where relative rotation of the sections forms a secure interconnection;

Figure 4 is a section of two lengths of pipe about to be joined, where male and female buttress type threads are provided on the interconnectable ends;

Figure 5 shows the interconnection of the pipe ends of Figure 4;

Figures 6 and 7 show a type of snap-fit interconnection of male and female components;

Figure 8 shows the ends of two pipe lengths adapted with male and female interconnections;

1           Figure 9 shows the wrapping of a bonding agent about the joint to secure the interconnection and;

          Figure 10 is a side elevation of a job site showing the pulling of interconnected lengths of plastic pipe into a buried pipeline to be relined.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

          Referring to Figure 1, a typical buried sewer line or stormdrain line is shown for purposes of illustrating the method according to the invention. It is appreciated,  
10           however, that the method is applicable to relining many other types of buried pipelines which, for one reason or another, are inaccessible, such as, lines for carrying corrosive chemicals, gasolines, oil lines, low pressure waterlines and the like. A typical street surface 10 has a service vehicle  
12 parked adjacent a manhole 14 which provides access to a sewer line 16 which is to be relined. The reason for the reline is usually due to corrosion, cracks resulting in a leak somewhere along the line which must be repaired. The sections or lengths of pipe generally shown at 18 are stacked  
20           behind an operator 20 who lowers each pipe section 22 down the manhole 14. An operator 24 is at the base of the manhole 14 and receives pipe 22 which is lowered down or through the access. The lengths or sections of pipe 22 are as shown and have provided at one end a male threaded portion 26 and a female threaded portion at the other end which is more clearly shown in Figure 4. The sections of pipe are placed in the buried pipeline 16 where each section is interconnected to the other before moving the interconnected sections sequentially into the pipeline 16. Each length of  
30           pipe 22 is such that it may be readily manouvered within the

1 confines of the lower area 28 of the manhole, so that the pipe may be oriented for insertion into the open end portion 30 of the pipeline, interconnected to the other sections of pipe and then moving the interconnected sections into the pipeline.

This procedure is repeated until a sufficient number of pipe lengths 22 have been interconnected and inserted into the pipeline to form a length of interconnected sections, as generally indicated at 32, so as to project from the other  
10 open end at 34 of the pipeline into the lower portion 36 of a manhole 38. At this point, the insertion of pipe sections is ceased and the connections, if needed, are secured to provide insertion renewal of faulty buried pipe 16. The ends of the pipe length 32 are sealed to the openings 30 and 34 so that all liquid running into the manhole areas 28 and 36 now pass into the interconnected length of piping 32. Special grouting materials, which set in water, may be used to seal the ends of the completed pipe section 32 to the openings 30 and 34 for the pipeline 16.

20 It is apparent that this process does not require any excavation of the pipeline system 16, nor does it require any stoppage in flow of waters or liquids along the line 16, since the operator with appropriate attire may stand at the base of the manhole and insert and interconnect these sections while liquid runs around the sections along the old pipeline 16.

Further aspects of the insertion and interconnection of the pipe lengths are shown in Figures 2 and 3. The base of the manhole is shown at 28 on which the workman may stand.  
30 Sewer line 40 runs into this area and flows into sewer line

1 16 which has its opening at 30. Each pipe section is inserted in the sewer line 16 as shown at 22. Due to the nature of the pipe being made of plastic such as polyethylene, polypropylene or polovinylchloride, the interconnected sections of piping 32 may take on various slight curvatures in the pipeline 16. The diameter of the pipe length 22 is less than the internal diameter of the pipeline to be relined to permit easy insertion of the sections into the pipeline and also movement of the

10 interconnected sections 32 along the pipeline. To facilitate forcing of the interconnected sections of piping 32 into the pipeline 16, particularly should it have a curvature or bend, a power drive device is used. As shown in Figure 2, the sections 32 are pushed into the pipe 16 by a power drive in the form of a jack 42 which is positioned against wall 44 of the manhole 14 and the jack ratchet 46 climbs the bar 48 of the jack 42 by operation of the hand lever 50 to push the interconnected pipe sections into the pipeline 16 in the direction of arrow 52. To protect the threaded end 26 of the

20 pipe 22, a plate 54 may be placed over or adapted to be threaded onto a portion of the thread 26 against which the ratchet plate 46 abuts. Once the pipe has been inserted to the desired extent into the pipeline 16, the protective plate 54 may be removed to permit interconnection of the next section of pipe 22.

It is appreciated that other power drive mechanisms may be used to force the interconnected piping 32 into the pipeline 16. For example, a device may be lowered into the manhole 14 which works on the basis of air pressure or

30 hydraulic pressure to push the interconnected sections into

1 the pipeline 16.

As shown in Figure 3, the securing of interconnect sections of pipe 22 to form a length of interconnected sections 32 is shown. In placing and interconnecting the pipe sections in the pipeline 16, they need not be tightly secured to one another simply loosely hand threaded. However, once the piping 32 projects from the other end 34 into the access area 36, chain clamps 56 and 58 may be secured over the projecting ends of the new pipe liner 32 and counterrotated in the directions of arrows 60 and 62 to tighten the threaded interconnections and thus cause an overall compression in the length of the pipeline in the direction of arrows 64. It is appreciated that several turns on the ends of the interconnected sections 32 are required so that there is in essence a sequential transfer of torque along the sections as each joint 66 in the series is firmly secured.

10

With regard to the tightening of the joint and its manner of operation, this is discussed in more detail with respect to Figures 4 and 5. In Figure 4, pipe sections 22 have on their end portions generally designated at 68 and 70 a female threaded portion 72 and a male threaded portion 74. A buttress type thread is provided on each end portion to resist separation of the interconnected joint 66. The end 70, which includes the male portions, has a projection 76 which abuts a sealing member in the form of an "O" ring 78 which is seated against a recess defined by ledge 80. The female end portion 68 includes a wedge-shaped projection 82 which is received in a wedge-shaped recess 84 of the male portion 70. The dimensional relationship of these

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1 projections and recesses is such to provide a secure  
interconnection, as shown in Figure 5. The wedge-shaped  
projection 82 firmly seats in the recess 84 in an overlapping  
fashion to provide a smooth surface along the joint 66, where  
there is no bulge in the external diameter of the pipe in the  
area of the joint 66. Thus, an essentially smooth surface  
for the interconnected sections 32 of the relining pipe is  
provided so as to be easily inserted into the pipeline 16.  
As the sections are tightened on one another, the projection  
10 76 deforms and squeezes the "O" ring seal 78 against the  
ledge 80 to provide an interior seal for the joint 66 to  
thereby prevent liquids leaking out of the joint. Such an  
arrangement is particularly useful when the relined pipeline  
is used in transporting liquids which may be under low  
pressure.

With the use of the buttress thread arrangement of  
Figure 4, an additional feature is realized in that, as shown  
in Figure 5, with projection 82 seated in the recess 84, upon  
pushing the interconnect sections 32 into the pipeline 16,  
30 stops are provided so as to maintain integrity of the joint  
while being pushed into the pipeline. Such interaction  
prevents the female portion of the interconnection sliding on  
up over the male portion and resulting in a faulty joint.

Alternative forms of pipe interconnections for the  
sections of Figure 1 are shown in Figures 6 through 9. In  
Figure 6, the pipe sections 22 have a formed male portion at  
86 and a formed female portion at 88 which have a snap-fit  
interconnectable relationship. The male portion 86 includes  
a ramp 90 with a recessed portion 92. The female portion 88  
30 includes a ramp 94 with inwardly disposed recessed portion

1 96. When the pipe sections 22 are pushed towards one  
another, the female section 88 expands slightly outwardly as  
the male section 86 contracts slightly to permit the sections  
to snap over one another. Ramp 94 rides up over ramp 90 so  
that the male projecting portion 90 snaps into the receiving  
recess 96 of the female portion, where the interaction of  
their abutting shoulders at 98 forms a secure interconnection  
of the pipe sections 22. The connection is such that the  
exterior of the joint 66 is essentially smooth to provide  
10 interconnected sections of piping 32 which is essentially of  
consistent diameter along the length of the reliner pipe.  
Such snap interconnections are convenient in situations where  
a forcing of the pipe sections into the pipeline results in  
the sections snapping together.

Figure 8 shows another approach to interconnecting of  
the pipe sections 22 where one section has a male portion 100  
and the other section has a female portion 102. The  
relationship is such to form an interfit, where the exterior  
of the pipeline remains essentially smooth as shown in Figure  
20 9 at joint 66 and the interior diameter is also essentially  
consistent across the joint. A bonding agent 104 is applied  
to the joint 66. This bonding agent may be in the form of a  
special pressure-sensitive adhesive tape which is wrapped  
about the joint to form the interconnection, or it may be of  
a special material which, after wrapping about the joint, is  
shrunk around the joint by the application of heat to form a  
shrink wrap and secure interconnection of the pipe sections  
22.

Referring to Figure 10, another aspect of the invention  
30 for interconnecting pipe sections in relining buried pipeline

1 is shown. Sections of pipe 106 may be interconnected mechanically, in accordance with this invention, and pulled into a buried pipeline 110 which needs to be relined. To facilitate pulling of the sections 106 into the buried pipeline 110, excavation is required in the area 112 to provide sufficient access such that the pipe interconnected sections may curve in the manner shown, as pulled into the pipeline 110. Thus, the pipeline is broken at 114 and 116 to provide an access opening at 116. At the manhole 118, a  
10 sheave 120 is secured in the lower area of the manhole at 122 and a sheave arrangement 124 is provided at the top of the manhole to guide the cable 126 to a winch not shown. A pulling head 128 is secured to the leading pipe section 106 where the pulling head 128 is adapted to be mechanically connected to the leading pipe section, for example by way of threading onto the female end portion of a threaded pipe section, such as shown in Figure 4 at 68.

The pipe sections 106 may be of longer lengths in view of the access provided at 112, where the pipeline 110, to be  
20 relined in this instance, may be of several hundred feet such as 500 to 1,000 feet of pipe to be relined at one time. This approach is superior to the butt fusion welding approach, in that no special tools are required because the sections can be readily assembled on site by simply twisting or snapping the sections together. The buttress thread is particularly useful in providing the interconnection, because it has a high degree of resisting separation while being pulled through the pipeline 110. With this arrangement, the diameter of the pipe sections is such to be slightly less  
30 than the mainline 110. This permits liquid to run around the

1 pipe sections as they are being inserted into the pipeline  
110.

This approach provides several advantages including the  
elimination of any external or internal couplings, where  
there are no interior projections within the pipe which would  
disturb the flow of liquids. The pipe sections can be  
readily dismantled for reservicing, since the plastic  
material does not corrode. The use of threaded  
interconnections facilitates bending along the length of  
10 interconnected sections as they are forced around various  
curves in the pipeline 110.

The method, according to this invention, and the pipe  
sections thereof provide for a very useful form of relining  
pipelines particularly in congested city areas where  
disruption of the street is kept to a minimum. A service  
vehicle may be parked at one manhole, an operator inserts the  
sections into the pipeline, forces them into position and  
seals the exposed ends to the manhole openings. This may all  
be accomplished in one day, which would normally take at  
20 least four times that long with prior methods.

Although preferred embodiments of the invention have  
been described herein in detail, it will be understood by  
those skilled in the art that variations may be made thereto  
without departing from the spirit of the invention or the  
scope of the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method for relining a buried pipeline with interconnectable plastic pipe sections comprising gaining access to an open end of the buried pipeline, passing pipe sections through the access area for assembly adjacent the open end of the buried pipeline, inserting individually each pipe section into the buried pipeline open end where each said pipe section is of a length to permit within the confines of the access area insertion of each pipe section into the pipeline open end and of a diameter to fit within the pipeline, mechanically interconnecting the pipe section to be inserted to the pipe section already inserted in the buried pipeline and moving such interconnected pipe sections into the buried pipeline to permit insertion of the next pipe section into the buried pipeline, said plastic pipe sections being made of a material selected from the group consisting of polyethylene, polypropylene and polyvinylchloride.
2. A method of claim 1 comprising pushing the interconnected pipe sections into the buried pipeline.
3. A method of claim 1 comprising pulling the interconnected pipe sections into the buried pipeline.
4. A method of claim 1 comprising using a pipe section diameter approximately 10% less than the internal diameter of the buried pipeline to be relined.
5. A method of claim 1 or 4 comprising using pipe sections of polyethylene.

6. A method of claim 1 comprising using a pipe section having the opposite ends provided with mating male and female thread portions to provide for threaded interconnection of pipe section ends.
7. A method of claim 6 comprising using threaded pipe sections having a male and female threaded interconnection which retains integrity of the threaded connections while under compression as the interconnected pipe sections are pushed into the buried pipeline.
8. A method of claim 1 comprising using pipe sections, each having opposite male and female end portions adapted for snap fitting interlock, on positioning the pipe section for insertion in the buried pipeline, pushing such pipe section to snap pipe sections together.
9. A method of claim 1 comprising using pipe section, each having opposite mating male and female end portions which overlap one another, securing the interconnection of one pipe section to another by wrapping a bonding agent over interconnected abutting pipe section end portions.
10. A method of claim 6 comprising using pipe sections having buttress threaded male and female end portions.
11. A method of claim 10 comprising sealing internally the interconnection of pipe section ends.
12. A method of claim 6 comprising inserting pipe sections and moving the interconnected pipe sections along the buried pipeline until the leading interconnected pipe section emerges

from a remote opening of the buried pipeline at another access area and rotating the pipe sections exposed at each access area to tighten the interconnections of all pipe sections along the length of the buried pipeline which has been relined.

13. A method of claim 3 comprising connecting a pulling head to the leading pipe section inserted in the buried pipeline, connecting a cable to the pulling head and sequentially pulling pipe sections into the buried pipeline as each pipe section is interconnected.

14. A method of claim 13 comprising using pipe sections, each having threaded male and female opposite end portions, the threaded portions being of the buttress thread type to resist separation of the interconnected pipe sections when the threaded connection is under tension.

15. A method for relining a buried pipeline with interconnectable plastic pipe sections while maintaining the flow of liquid carried by the pipeline comprising gaining access to an open end of the buried pipeline, passing pipe sections through the access area for assembly adjacent the open end of the buried pipeline, each of said pipe sections being of a length to permit within the confines of the access area insertion of each pipe section into the pipeline open end and of a diameter to fit within the pipeline, mechanically lockingly interconnecting the pipe section to be inserted to the pipe section already inserted in the buried pipeline and moving such interconnected pipe sections into the buried pipeline to permit insertion of the next pipe section into the buried pipeline.

16. A length of straight plastic pipe for use in relining buried pipelines, said pipe being made from a plastic selected from the group consisting of polyethylene, polypropylene and polyvinylchloride, said pipe having its ends adapted for interconnection of its ends to other like pipe lengths, the mating interconnection of pipe ends retaining its integrity as interconnected lengths of pipe are moved within the buried pipeline to reline same.

17. A length of pipe according to claim 16, wherein said length of pipe has a male portion at one end and a female portion at the other end, said male and female portions forming a mating interconnectable interfit between two like lengths of pipe.

18. A length of pipe according to claim 17, wherein said male and female end portions are buttress type threads.

19. A length of pipe according to claim 17, wherein said male and female end portions provide a snap-fit interconnection.

20. A length of pipe according to claim 17, wherein said male and female end portions are retained in interconnected relationship by a bonding agent wrapped around the pipe section joint.

21. A length of pipe according to claim 18, wherein said buttress thread is arranged to resist separation between interconnected lengths of pipe and abutting stop portions are provided on mated pipe ends to maintain joint integrity while under compression.

22. A length of pipe according to claim 21, wherein a seal is provided interiorly of the joint.

23. A length of pipe according to claim 21, wherein said joint between lengths of pipe is of the same diameter as the pipe to provide a consistent exterior diameter over the length of interconnected pipes.

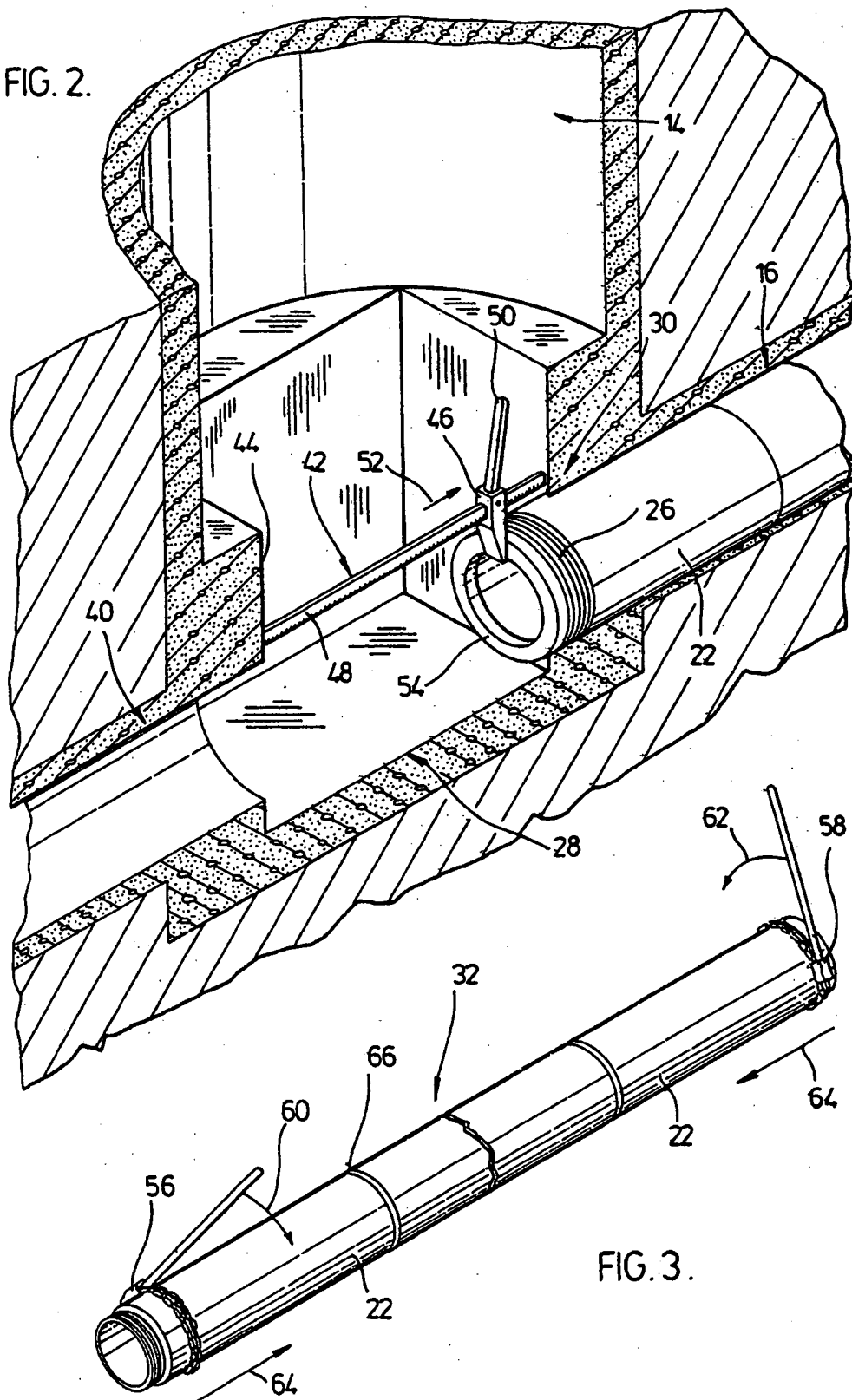
24. A length of pipe according to claim 18, wherein said pipe is made of polyethylene, said buttress thread being machined at each pipe end, the pipe end having the male threaded portion being provided with an annular recess rearwardly of the threaded portion, the pipe end having the female threaded portion being provided with an annular projection for insertion within said annular recess.

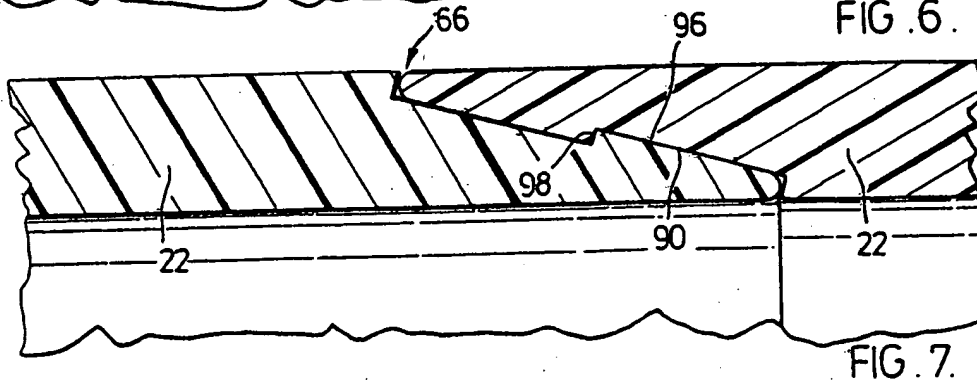
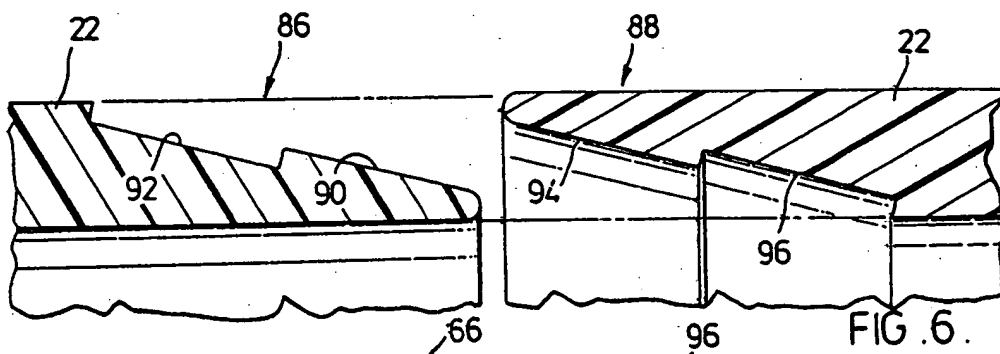
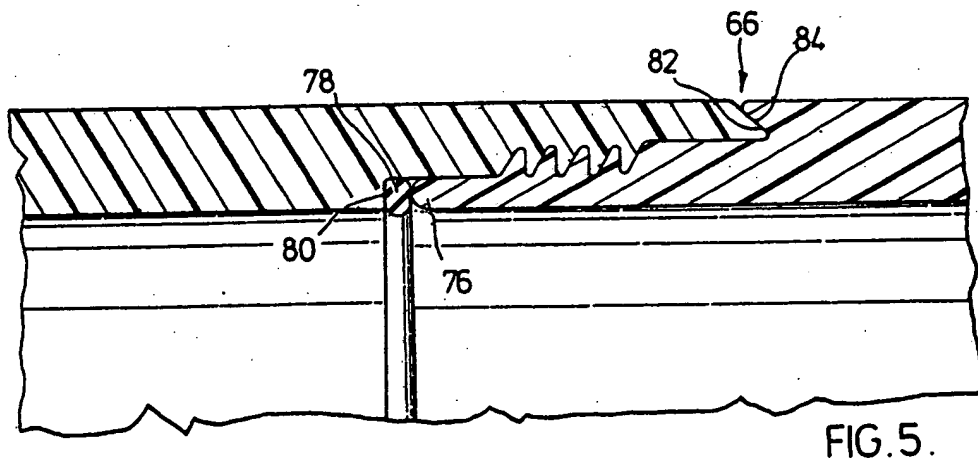
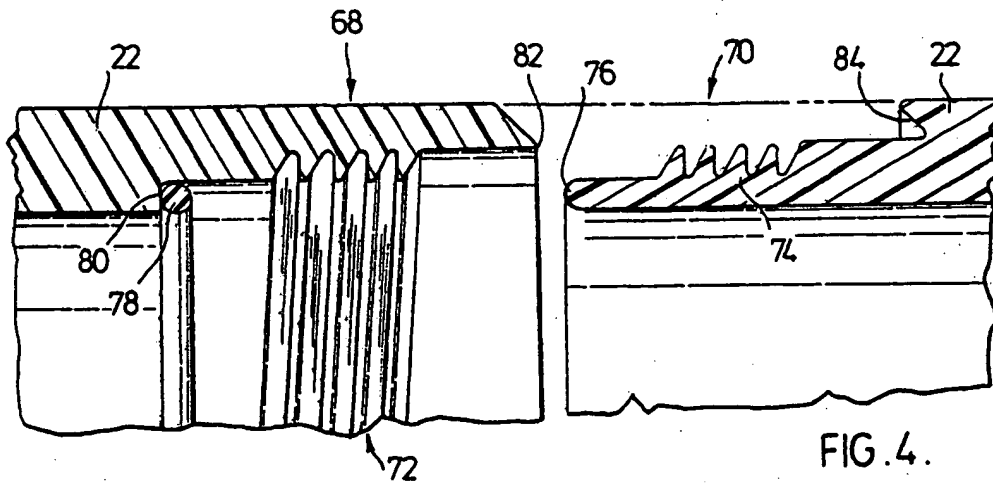
25. A length of pipe according to claim 24, wherein said pipe end having the male thread being provided with a secondary annular projection forwardly of the threaded portion, the pipe end having the female thread portion being provided with a secondary annular recess to receive said secondary annular projection, an annular sealing member being provided in said secondary recess to provide an interior seal for the joint between lengths of pipe by said secondary annular projection contacting and deforming said sealing member on tightening the threaded interconnection of lengths of pipe.

26. A length of pipe according to claim 25, wherein said annular projection on said female threaded portion is received within said recess in a manner to abut one another with said sealing member deformed.

FIG. 1.

FIG. 2.





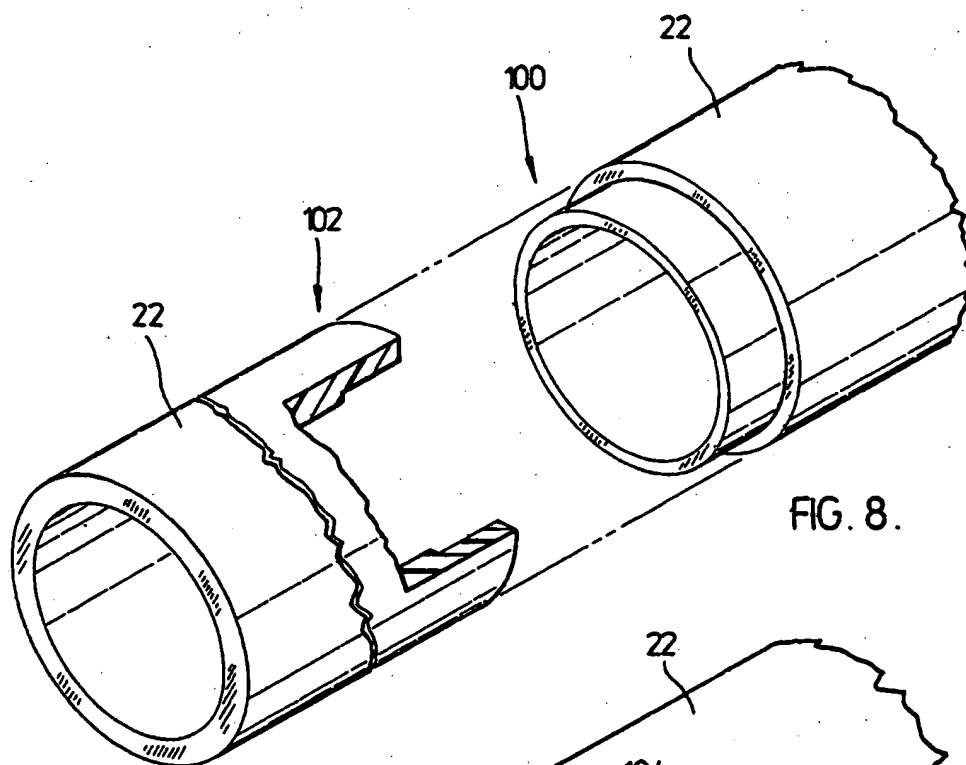


FIG. 8.

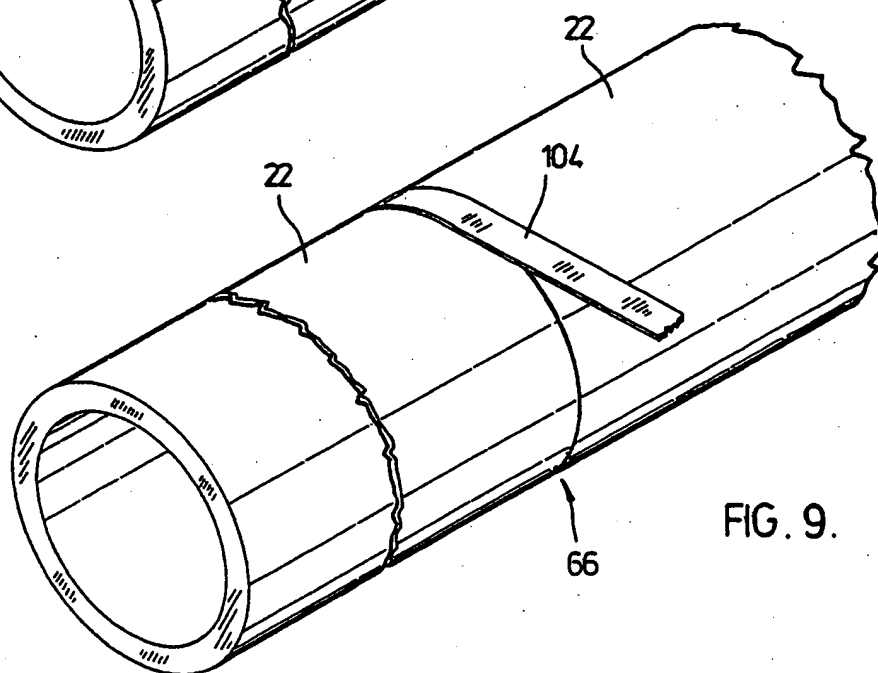


FIG. 9.

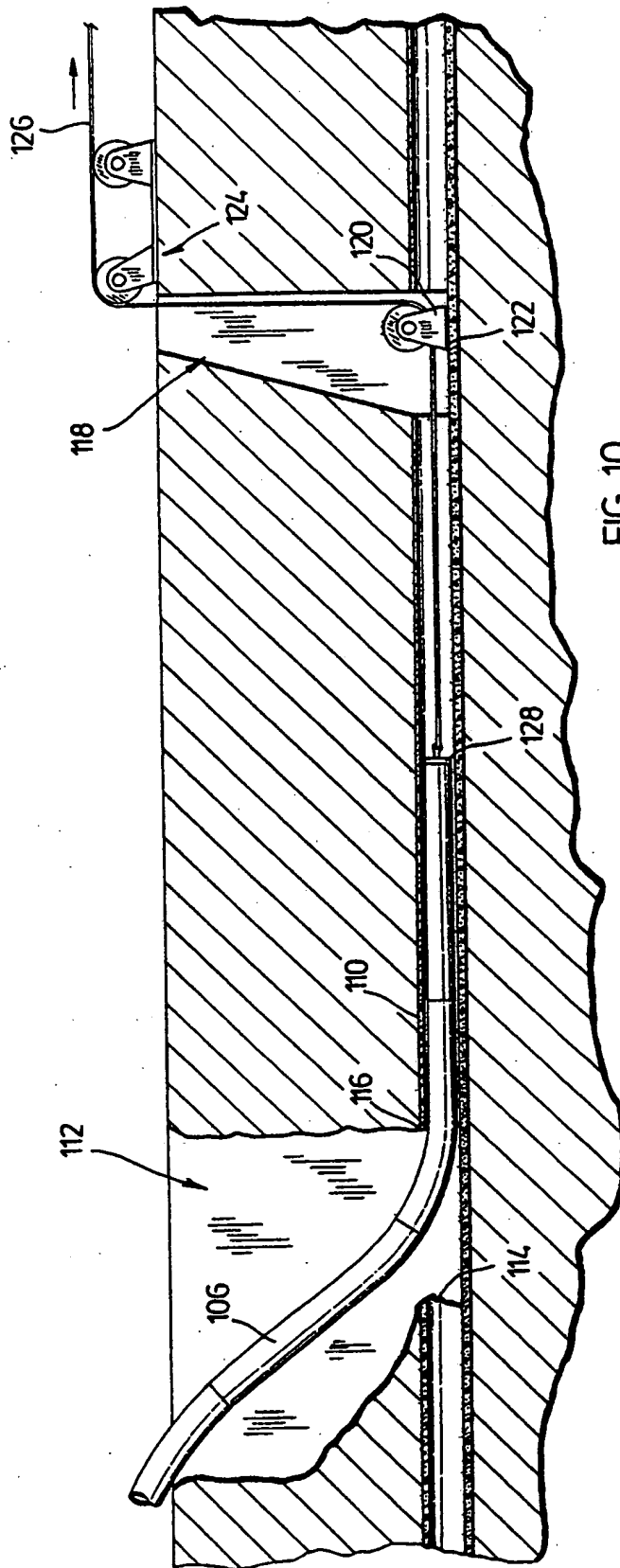


FIG. 10.